

Developing a framework for participatory research approaches in risk prone diverse environments

Kirsten Probst¹, Jürgen Hagmann², Thomas Becker¹, Maria Fernandez³

¹University of Hohenheim, Agric. Communication & Extension (430A)
D-70593 Stuttgart, Germany, Fax: +49 (711) 459 2652,
kprobst@uni-hohenheim.de, thbecker@uni-hohenheim.de

²Development consultant, Talstrasse 129, 79194 Gundelfingen, Germany
jhagmann@aol.com

³Profesora Visitante, Investigacion Participativa, Universidad Nacional Agraria
Casilla R18-067 Lima 18, Peru, mefernandez@lamolina.edu.pe

Abstract

The paper provides a *typology of approaches* to innovation development: Four prototypical approaches were identified and described along key characteristics (objectives, types of participation, actors involved, roles, procedures, research methods). Most participatory research activities in the CGIAR are at the level of applied and adaptive research, and participatory research is frequently seen as a better way of technology transfer. In view of the complex challenges in natural resource management (NRM), which are a function of technical skills and know-how as well as social negotiation, organization and rules, it is recommended that the CGIAR should broaden and reconsider its NRM research strategies in risk prone and diverse environments by enhancing the use of participatory learning and action research.

Keywords: participatory research approaches, Consultative Group on International Agricultural Research (CGIAR), natural resource management

1 Background

Nowadays, it is widely agreed upon that local people's perspectives need to be in the center of development-oriented research and extension efforts, if substantial impact should be made. Participatory research is one key element to involve farmers in the (formal) process of innovation development. Over the last decades, a great diversity of participatory research approaches has evolved, however, it is not yet well understood which types of participatory approaches are useful for which kind of

research questions, goals and contexts. The practice of 'participation' is still rather diffuse and difficult to assess in terms of quality, whereas the rhetoric of participation is still fashionable and needs to be strategically used and included in almost every research proposal if chances for funding are to be high.

The objective of this paper is to shed some light on the multiplicity of participatory approaches used in International Agricultural Research and to structure and classify this diversity through a *typology of approaches*. The purpose of such a typology is to establish a more differentiated language and a conceptual framework, that can help research managers and practitioners to make better choices and more informed decisions when designing their research approach. The paper mainly focuses on the situation of participatory research in the *Consultative Group on International Agricultural Research (CGIAR)* as a dominant actor in international agricultural research who is increasingly committed to address the natural resource management problems of the poor in less-endowed and risk-prone areas (CGIAR 1995).

Findings are based on a review of literature and internet sites, discussions with key informants, and a questionnaire-based study of 53 research projects carried out during 1999 by the *CGIAR Systemwide Program on Participatory Research and Gender Analysis (PRGA Program)*. This information was analyzed in order to single out a set of prototypical approaches and to assess the state of the art of participatory research in the CGIAR.

2 Key variables to describe and differentiate between research approaches

Based on a review of cases and experiences with innovation processes the following key distinguishing variables were identified as appropriate to classify different approaches to innovation development:

- *Epistemological assumptions*
- *Objectives of research*
- *Types of participation*

- *Roles of 'external' and 'local' actors:*
- *Actors' involvement*
- *Procedures/Process*
- *Research methods:*

The description of these variables can serve as a checklist to analyze participatory research approaches.

Epistemological assumptions: Since the 17th century, scientific investigation has come to be dominated by the 'Cartesian' worldview that is called 'positivism' or 'rationalism' (Pretty 1995: 13). The underlying assumption of positivist science is the existence of an objective, value-free external reality, driven by immutable and universal laws. Scientists seek to investigate and discover the true nature of this reality, the ultimate aim being to discover, predict and control natural phenomena. As a result, knowledge derived from science is equated with 'truth' and is perceived as superior to other forms of knowledge. Technology is considered to be value-free and culturally neutral. An alternative perspective is based on constructivism (Berger & Luckmann 1967; Watzlawick 1976; Maturana & Varela, 1979; Glasersfeld, 1987). The premise for this paradigm is the perception that there is no objective external reality. Rather through communication and learning processes different social groups develop an inter-subjective system of knowledge, concepts, beliefs, theory and practice that they consider to be reality. Under the constructivist paradigm, technologies are not value-free, not culturally neutral, and not 'portable' across organizations and cultures (Hagmann 1999: 42). The underlying research paradigm has implications on the roles different actors adopt in an innovation process, and the methods used (Hagmann 1999).

Objectives of research: The principal purpose of research is to generate knowledge and a better understanding of complex processes. This, in turn, might lead to new products (technologies, management or policy recommendations), and to an impact at local level – either directly, through a joint research process at local level or indirectly, through the application of research products by others. Depending on the NRM

challenge addressed through research, different kinds of innovations are required: technical, social/organizational innovations and/or new methods and approaches. The expected research output might be applicable at different geographical levels and be targeted to different users.

Types of participation: Talking about 'participatory research approaches', we generally refer to a process of interaction between local and external actors to 'co-create' innovations. Biggs (1989) described different types of participation according to varying degrees of involvement in and control over decision-making in the process:

- **CONTRACTUAL PARTICIPATION:** One social actor has sole decision-making power over most of the decisions taken in an innovation process, and can be considered the 'owner' of this process. Others participate in activities defined by that stakeholder group, i.e. they are (formally or informally) 'contracted' to provide services and support.
- **CONSULTATIVE PARTICIPATION:** Most of the key decisions are kept with one stakeholder group, but emphasis is put on consultation and gathering information from others, especially for identification of constraints and opportunities, priority setting and/or evaluation.
- **COLLABORATIVE PARTICIPATION:** Different actors collaborate and are put on a more equal footing, emphasizing linkage through an exchange of knowledge, different contributions and a sharing of decision-making power during the innovation process.
- **COLLEGIATE PARTICIPATION:** Different actors work together as colleagues or partners. 'Ownership' and responsibility are equally distributed among the partners, and decisions are made by agreement or consensus among all actors.

The question of ownership needs to be considered when defining 'participation': *Who is participating in whose process?* Scientists might allow farmers to participate in the formal research process using different types of participation, or on the contrary researchers might participate to varying degrees in a locally owned innovation process.

Research managers often pursue different objectives and expect different outcomes from local people's participation.

- **LEGITIMIZATION:** Participation is evoked to obtain local peoples' consent for outsiders to do what they perceive as important, or participation might be used because it is 'fashionable' and expected by donors.
- **EFFECTIVENESS & EFFICIENCY:** Participation is used to make use of local knowledge, to better understand farmers' needs and to improve the effectiveness and efficiency of formal research.
- **CAPACITY BUILDING / LEARNING:** Participation is a means to gaining practical experience through working together, and being involved in analysis, planning and decision-making. It leads to personal and professional growth among local people and researchers (changes in attitude, improved communication skills, management and organization capacity, etc.). This is closely related to the following purpose:
- **EMPOWERMENT / TRANSFORMATION:** Participation is considered to be a means of enhancing local people's capacity for self-directed innovation development. It is seen to increase capacity for the articulation and negotiation of interests, leadership, collective action, as well as critical consciousness, and self-esteem among (marginalized) social groups.

Roles of 'external' and 'local' actors: The roles external and local actors take on in an innovation process is reflected in terminology (even though expressions are frequently used indiscriminately): Local people might be perceived as 'clients', 'beneficiaries', 'users', 'target group', or 'partners'. On the contrary, external actors might regard themselves as 'service provider', 'advisor', 'facilitator', 'stakeholder', or 'partner'.

Actors' involvement: It is critical to sort out, not only how actors work together in a joint research process, but also who is involved (or excluded): individuals, different stakeholders, organized groups, experts, representatives, etc. This influences the type, usefulness and social inclusiveness of the innovations that emerge from a research process.

Therefore, an important distinguishing aspect among participatory approaches is the degree to which actors are differentiated, sought to participate in and bring knowledge to an innovation process (Ashby 1996).

Procedures/Process: The procedure to be followed up in an approach can be 'top-down', 'bottom-up' or 'horizontal' depending on who provides directions and who is accountable to whom. Processes can also be designed to reinforce 'linear' information and knowledge flows, or they can prioritize the facilitation of 'iterative learning loops'. A linear approach is generally characterized by rigorous planning, fixed roles, clearly defined procedures and stages of research, and an emphasis on the production of clear outputs. Evaluation tends to be done at the end of a project phase (ex-post). On the other hand, an approach characterized by iterative loops of action and reflection in a collective learning process is based on evolving plans and continuous internal monitoring and evaluation. The latter, process-oriented approaches, require 'organic' or learning organizations with a high degree of flexibility.

Research methods: An approach to innovation development might rely on formal research methods or on informal experimentation; it might involve 'hard systems' research methods, or 'soft systems' learning and action research. Hard systems approaches assume that the variables under study are measurable, that the relationships between cause and effect are consistent and may be discovered by empirical, analytical and experimental methods. On the other hand, soft systems thinkers argue that systems are creations of the mind or theoretical constructs to understand and make sense of the world. Hence, soft systems methods aim at generating knowledge by stimulating self-reflection, discourse and learning (Hamilton 1995: 35 - 36).

3 A typology: Prototypical approaches to innovation development

Based on an analysis of participatory research approaches used in the CGIAR, the history of technology transfer during the past five decades and the mainstream in literature, we identified four prototypical

approaches to innovation development which we would like to suggest as a framework for a typology of participatory approaches. It needs to be stressed that in practice, precise boundaries cannot be drawn between the suggested approaches. The four prototypical approaches are:

- the transfer of technology approach,
- farmer first,
- participatory learning and action research, and
- farmer-controlled research.

Transfer of Technology: This linear model which reflects the modernistic development perspective of the 1960's and is based on the positivistic science paradigm includes mainly three actors: *Researchers* who are responsible for providing scientifically valid research results, *extensionists* who 'transfer' the message to *farmers*, who have the role of adopters or rejecters of innovations developed by others. The division of research into different categories (basic, strategic, applied, adaptive research) – and rather limited institutional mandates still reflect that innovations are considered to be the result of a linear process of applying scientific knowledge in practice (Hagmann 1999: 36). Usually the transfer of technology model is viewed as the antithesis of participatory research. However, until today, most participatory research activities in the CGIAR are at the level of applied and adaptive research, and participatory research is frequently seen as a better way of technology transfer. Much of the participatory research work can be classified as an expansion of the transfer of technology model, because information is obtained from farmers and analyzed by professionals to decide on potential solutions, and on the design of experiments (Chambers 1993:69). The transfer of technology model, aiming at a widespread adoption of technologies, is likely to be successful in relatively homogenous, low-risk, natural and social environments, where farmers live under similar conditions, perceive the same kinds of challenges and share a common set of beliefs and values.

Farmer First: Chambers (1989, 1993:66) describes a family of approaches summarized under 'Farmers First', including for example

Farmer-back-to-Farmer (Rhoades and Booth 1982), Farmer First and Last (Chambers and Ghildyal 1985), Farmer Participatory Research (Farrington and Martin 1987), and Participatory Technology Development (ILEIA 1989). Their main commonality is an emphasis on the participation of farmers in the generation, testing, and evaluation of technology to promote sustainable agricultural production. The main outcome expected from farmer participatory research is the generation and adoption of new, appropriate technologies by small, resource-poor farmers that should help in solving production constraints in order to increase farm productivity and income (Selener 1997). The positivist paradigm is still prevalent in these approaches. Local knowledge is viewed as a uniform 'stock', which is available for assimilation and incorporation. The role of researchers is to collect information, document rural peoples knowledge, to plan and manage interventions. Farmers mainly act as respondents and are involved in planning and implementation (Hagmann 1999: 45). In general, formal research methods and controlled comparison are used.

Participatory Learning and Action Research: According to this model innovation is considered to be the outcome of a mutual learning process between a multiplicity of actors and networks through which certain kinds of technical and social information are communicated and negotiated. Learning process approaches are based on a constructivist perspective. The mandate of science is no longer satisfied by scientists themselves developing knowledge for people. Instead, science's mandate would include helping people at different levels of social aggregation to develop knowledge (Röling 1996:40). This collaborative work requires dialogue, negotiation and empowerment. The 'learning paradigm' requires a 'new professionalism'. It is recognized that there are differentiated goals and conflicting interests between actors, and that local knowledge often is fragmented and diffuse. Issues like bridging, dispute resolution, and conflict mediation are becoming focal points. Action learning, experiential and experimental learning (Kolb 1976, 1984; Rogers 1992; Cornwall et al. 1994), social learning and soft systems methodology (Checkland 1981, 1985; Röling 1994, 1995, 1996; Engel 1997), discovery learning

(Hamilton 1995) are all approaches which build on the potential of 'learning by doing' in a cycle of action and reflection in order to create practical knowledge. Participatory action research approaches have long been known in schools (B.R. Buckingham 1926), organization building (Kurt Lewin 1946), and community development (Paulo Freire 1970).

Farmer-controlled research: In this model local organizations who have appropriate communication channels to institutions or enterprises and who have control over (own or donated) resources, initiate contracts with providers of research services to overcome specific constraints. They act as clients who commission external service providers, and 'buy-in' research services. As a result these groups can demand accountability, whereas external actors are responding to their requests. This model builds a bridge between the 'Transfer of Technology' and 'Learning and Action Research' approaches, as it puts local people in a position of greatest power, whereas innovations are generated by 'externals'. This approach is likely to work where the innovation that is requested by local organizations brings about cash income. Table 1 gives an overview of the four prototypical approaches and their respective attributes.

4 Participatory Research in the CGIAR: State of the Art and Challenges

Looking at the centers' research programs and inter-center initiatives it becomes obvious that NRM research efforts show a high level of diversity in terms of objectives, levels, research partners, approaches, and intended users of research outputs. NRM topics that are dealt with in the CGIAR range from technologies that can be adopted by individual farms, such as crop/livestock management practices, soil and water management, agroforestry, integrated farming systems (ICRAF, CIMMYT, CIP, ICRISAT, IRRI, WARDA, IITA), to NRM techniques and social innovations that require coordination between people, and collective action at landscape level, such as integrated pest management (IITA, CIP, IRRI), forestry (CIFOR), conservation of biodiversity (CIFOR, IPGRI, ICLARM), irrigation (IWMI), fisheries (ICLARM); and watershed

Table 1: Types of approaches to innovation development and their respective attributes

	Farmer-controlled	Transfer of Technology	Farmer First	Learning & Action Research
Assumptions concerning innovation development	<ul style="list-style-type: none"> Organizations have appropriate communication channels with institutions or enterprises and have control over (own or donated) resources; they initiate contracts with providers of research services to overcome concrete constraints Groups can demand accountability The innovation will generate cash income 	<ul style="list-style-type: none"> Homogenous social systems in which the innovation is of equal relevance to all; users/clients in a given area suffer from the same kinds of constraints and share a common set of conditions. Innovation is a result of a linear process by which scientific knowledge is applied in practice Innovations diffuse from 'innovative' farmers to other farmers. 	<ul style="list-style-type: none"> Common goals, interests and power among 'farmers' and 'communities' 'Stock' of uniform, systematized, local knowledge available for assimilation and incorporation Recognition that farmers have something to contribute to innovation development 	<ul style="list-style-type: none"> Differentiated interests and goals, power, access to resources between 'actors' and 'networks' Multi-layered, fragmentary, diffuse knowledge with complex, inequitable discontinuous interactions between (local and external) actors and networks Innovation as a result of interaction among different actors with complementary contributions.
Objectives and Challenges	From farmers' point of view: solution of concrete production constraints; From researchers'/enterprise's perspective: income generation	Widespread adoption of technology (e.g. for national food security, economic growth, natural resource conservation)	Wider choices for resource-poor farmers in complex and diverse environments	Empowerment & social capital building; Initiating a process of continuous adaptation and problem solving; Building of stakeholder platforms as a forum at which various negotiations and learning processes can take place
Types of participation	Farmer-initiated: Contractual - Consultative	Researcher initiated: Contractual – Consultative	Researcher initiated: Consultative – Collaborative	Researcher or Community-initiated: Collaborative – Collegiate
Actors and Stakeholders	Production-based organizations or cooperatives, research enterprises	Research, extension, individual / 'innovative' farmers	Research / extension, 'farmers', communities	Multiplicity of local and external stakeholders (e.g. farmers, men / women, traders, research/ extension services, policy makers etc.)
Role of External Actors	Development of solutions to problems, which have been formulated and identified by clients (service providers)	Development and transfer of messages and technologies	Information collector of rural people's knowledge, planner of intervention, manager of implementation, more recently: facilitator, initiator, catalyst (provider of principles, formal research methods, basket of choices)	Facilitator, initiator, catalyst, provider of occasions and methodological support, visible actor/stakeholder in process learning and action ('new professionalism'); supporter of farmer-led research
Role of Local Actors	Clients of services and products developed by service providers	Beneficiaries, target group; Reactive respondent, provider of labor/land for on-farm research	Reactive respondent or active participant	Creative investigator, active participant (actor) and partner in the process of learning and action
Procedures	<ul style="list-style-type: none"> Linear bottom-up process Demand is formulated by clients Evaluation by clients 	<ul style="list-style-type: none"> "top-down" process Static plan, rapid and widespread implementation Outsiders analyze needs and priorities 'fixed menu' linear, clearly defined stages of research External intermittent evaluation 	<ul style="list-style-type: none"> Farmers analyze needs and priorities facilitated by outsiders 'menu à la carte' 'Farmer' or 'community' consensus solutions to identified problems Managed intervention, designed solutions and planned outcomes with farmer involvement in planning and implementation 	<ul style="list-style-type: none"> Iterative loops of action and reflection in a collective learning process Evolving plan, adaptive management, gradual local implementation Collaborative work requiring dialogue, negotiation and conflict mediation between interest groups Internal continuous evaluation
Research methods	Hard systems research (laboratory, on-farm research)	Hard systems research (AEA, FSR, RRA)	Formal research methods, FSR, RRA, some PRA, FPR, PTD, GA	Soft systems learning and action research, stakeholder analysis, PAR, FPR, PRA, PTD, informal farmer experimentation, comparative case studies

management (CIAT, ICRISAT). Responses gained from the questionnaires reveal, that the major NRM challenges projects address are: lack of knowledge and technology (63%), and organizational and management problems in NRM (50%). Even though technical innovations (varieties, farming practices, etc.) as a research output are still of major relevance, methodological tools and guidelines, as well as organizational innovations are becoming increasingly important products in NRM research. 88% of the projects who responded to the questionnaire said that small farmers and communities (local resource managers) are supposed to be the beneficiaries of their research. However, the primary intended users of the research outputs were mainly other institutions (NARS, NGOs, extension and development workers) and policy makers.

The fact that participation has become a basic principle in development co-operation and that it is increasingly requested by donors, has given strong impetus to participatory approaches in the CG-System. However, most participatory research activities in the CGIAR are at the level of applied and adaptive research, and participatory research is frequently seen as a better way of technology transfer, which is considered to be the task of NARS, extension services and NGOs rather than of CGIAR Centers. Participatory research is mainly seen as a functional tool or an event for problem analysis or evaluation, which requires a couple of hours rather than a long term process (Becker 2000). Critics argue that participatory research is no 'proper science', and therefore experiments should be of an adaptive sort only. Those who are advocating participatory research as a means of empowerment, equity and capacity building are looked upon as 'muddying the waters' by mixing development driven agendas with research-driven ones (Humphries et al. 1999).

There are few innovative initiatives which put more emphasis on the human dimension of NRM, and which apply participatory research in strategic and pre-adaptive research, for example in approach development and to learn systematically about conceptual lessons in

organizing and implementing NRM. Examples of participatory learning and action research approaches, where scientists facilitate and support people's efforts in seeking solutions for constraints they have identified at local level, are still scarce in the CGIAR. One innovative example is CIFOR's Adaptive Co-Management Project. In this case, participatory action research approaches are applied in a number of case studies, where researchers facilitate the process of local research and seek answers to more strategic research questions. Another example are CIAT's local agricultural research committees, CIALs (Ashby & Sperling 1995).

Scientists with real field experience in participatory research are still a minority in the CGIAR, and the reward system is largely based on the production of data and product outputs for use at meso and macro level, instead of impact and process results at local level (CGIAR-INRM-Group 1999). One major weakness is that the CGIAR has largely avoided epistemological questions about the theoretical assumption underlying its understanding of knowledge and science (Becker 2000).

5 Conclusions

In view of the complex challenges in natural resource management, where other activities beyond the conventional disciplines of agriculture, animal husbandry, forestry, and their interfaces become important, the CGIAR needs to broaden and reconsider its natural resource management research strategies. This applies particularly with regard to collective action at landscape level, organization building, land use planning, and conflict and information management (Janssen 1995; Probst 2000). Participatory learning and action research approaches at the grassroots level combined with strategic research through comparative case studies are indispensable, if International Agricultural Research is to achieve an impact in risk prone and diverse environments. This in turn requires that the CGIAR achieves more clarity about its mandate (international public goods requirement, strategic research, epistemology), the relevance of participatory research in this field, and the interface between extension and development. CG

scientists need to broaden their understanding of various options and elements in the design of research approaches, and need to build their facilitation and process management skills. Ultimately, the development of these 'new' skills will determine the quality and success of participatory approaches in the future.

Bibliography

Ashby JA, Sperling L (1995) Institutionalizing participatory, client-driven research and technology development in agriculture. *Development and Change* 26 (4): 753-770.

Ashby JA (1996) What do we mean by participatory research in agriculture? In: *New frontiers in participatory research and gender analysis. Proceedings of the International Seminar on PRGA, September 9-14, 1996, Cali, Colombia. CIAT Publication 294: 15-22.*

Becker T (2000) Participatory Research in the CGIAR – A Discussion Paper. Presented at the NGO-Workshop “Food for all – Farmer First in Research” accompanying the GFAR 2000 in Dresden, 19-20 May 2000. (unpublished)

Berger PL, Luckmann T (1967) *The social construction of reality. A treatise in sociology of knowledge.* Anchor Books, Garden City.

Biggs SD (1989) Resource-poor farmer participation in research: a synthesis of experiences from nine National Agricultural Research Systems. OFCOR Comparative Study Paper. ISNAR, The Hague: 3-37.

Buckingham BR (1926) *Research for Teachers.* Burdett and Co., New York.

CGIAR (1995) Ministerial Level Meeting. February 9-10, 1995, Lucerne, Switzerland. *Renewal of the CGIAR. Declaration and Action Program.*

CGIAR-INRM-Group (1999) *Integrated Natural Resource Management. The Bilderberg Consensus. Summary Report of the INRM workshop held at Bilderberg, The Netherlands, 3-5 September 1999.* (<http://www.inrm.cgiar.org>)

Chambers R, Ghildyal BP (1985) Agricultural research for resource poor farmers – the farmer first and last model. *Agricultural Administration and Extension* 20:1-30.

- Chambers R, Pacey A, Thrupp LA (eds.) (1989) Farmer first. Farmer innovation and agricultural research. IT Publications, London.
- Chambers R (1993) Challenging the professions. Frontiers for rural development. IT Publications, London.
- Checkland PB (1981) Systems thinking, systems practice. Wiley, Chichester.
- Checkland PB (1985) From optimising to learning: A development of systems thinking for the 1990s. Journal of Operational Research and Society 36 (9):757-767.
- Cornwall A, Guijt I, Welbourn A. (1994) Acknowledging process: Challenges for agricultural research and extension methodology. In: Scoones I, Thompson J (eds) Beyond farmer first. Rural people's knowledge, agricultural research and extension practice. IT Publications, London, pp 98-117.
- Engel PGH (1997) The social organization of innovation. A focus on stakeholder interaction. Royal Tropical Institute KIT, Amsterdam.
- Farrington J, Martin N (1987) Farmer participatory research: A review of concepts and practices. ODI Discussion Paper 19, London.
- Freire P (1970) Pedagogy of the Oppressed. Seabury Press, New York.
- Glaserfeld E von (1987) Wissen, Sprache und Wirklichkeit. Arbeiten zum radikalen Konstruktivismus. Vieweg, Braunschweig, Wiesbaden.
- Hagmann J (1999) Learning together for change. Facilitating innovation in natural resource management through learning process approaches in rural livelihoods in Zimbabwe. Kommunikation und Beratung 29. Margraf Verlag, Weikersheim.
- Hamilton NA (1995) Learning to learn with farmers. A case study on an adult learning project conducted in Queensland, Australia 1990-1995. Unpublished Ph.D. Thesis, Wageningen Agricultural University, Wageningen.
- Humphries S, Gonzales J, Jimenez J, Sierra F (1999) Searching for sustainable Land Use in Honduras. Report prepared for IDRC, Canada, August, 1999. (unpublished report)
- ILEIA (1989) Participatory technology development: A selection of publications. ILEIA, Leusden.

- Janssen W (1995) Characteristics of NRM research: Institutional and management implications. Paper presented at an ISNAR Workshop, December 6-9, 1994. IRD Currents 9: 22-29. International Rural Development Center (IRDC), Swedish University of Agricultural Sciences, Uppsala, Sweden.
- Kolb DA (1976) Learning Style Inventory Manual. Boston.
- Kolb DA (1984) Experiential Learning. New York.
- Lewin K (1946) Action Research and Minority Problems. Journal of Social Issues 2: 34-46.
- Maturana HR, Varela FJ (1979) Autopoiesis and Cognition. Boston Studies in the Philosophy of Science. Reidel, Boston.
- Pretty JN (1995) Regenerating agriculture. Earthscan, London.
- Probst K (2000) What are success factors in natural resource management research? Dissection of a complex discourse. In: Lilja N, Ashby JA, Sperling L (eds) Assessing the Impact of Participatory Research and Gender Analysis. CGIAR Program on Participatory Research and Gender Analysis, CIAT, Cali, Colombia. (in press)
- Rhoades RE, Booth RH (1982) Farmer back to farmer: A model for generating acceptable agricultural technology. Agricultural Administration 11:127-137.
- Rogers A (1992) Adults learning for development. Reprinted 1993, 1994, 1996. Cassell, London.
- Röling NG (1994) Creating platforms to manage natural resources: First results of a research program. In: Systems-oriented research in agriculture and rural development, International symposium held in Montpellier 21-25 November 1994, Papers published by CIRAD-SAR, Montpellier, pp 391-395.
- Röling NG (1995) Creative resource management: The application of the ecological imperative. Paper presented at a workshop on 'Extension Intervention and Local Strategies in Resource Management: New Perspectives on Agricultural Innovation in Zimbabwe', held January 10-12, 1995, Harare, Zimbabwe. Department of Agricultural Economics and Extension, University of Zimbabwe, Harare.
- Röling NG (1996) Towards an interactive agricultural science. European Journal of Agricultural Education and Extension 2 (4):35-48.

Selener D (1997) Participatory Action Research and Social Change. Cornell Participatory Action Research Network. Cornell University, Ithaca, New York, USA.

Watzlawick P (1976) Wie wirklich ist die Wirklichkeit? – Wahn, Täuschung, Verstehen. Serie Piper, München Zürich.